Relational Algebra Equivalences

- Allow us to choose different join orders and to `push' selections and projections ahead of joins.
- Rules on joins, cross products and union

$R \bowtie S = S \bowtie R$

$(R \bowtie S) \bowtie T = R \bowtie (S \bowtie T)$

$R \times S = S \times R$

$(R \times S) \times T = R \times (S \times T)$

R U S = S U R

R U (S U T) = (R U S) U T

Rules: Selects

$\sigma_{p1 \wedge p2}(R) = \sigma_{p1}\ [\sigma_{p2}(R)]$

$\sigma_{p1 \vee p2}(R) = [\sigma_{p1}(R)] \cup [\sigma_{p2}(R)]$

Rules: Project

Let: X = set of attributes

Y = set of attributes

XY = X U Y

$\pi_{xy}(R) = \pi_x[\pi_y(R)]$

Rules: Project

Let: X = set of attributes

Y = set of attributes

XY = X U Y

$\pi_{xy}(R) = \cancel{\pi_x[\pi_y(R)]}$

$\pi_x(R) = \pi_x[\pi_y(R)]$ if y contains x

Rules: $\sigma + \bowtie$ combined

Let P = predicate with only R attribs

Q = predicate with only S attribs

M = predicate with only R,S attribs

$\sigma_p(R \bowtie S) = [\sigma_p(R)] \bowtie S$

$\sigma_q(R \bowtie S) = R \bowtie [\sigma_q(R)]$

More Rules

Let x = subset of R attributes

z = attributes in predicate P

(subset of R attributes)

$\pi_x[\sigma_p(R)] = \pi_x\{\sigma_p[\overset{\pi_{xz}}{\cancel{\pi_x}}(R)]\}$

More Rules

Let x = subset of R attributes

y = subset of S attributes

z = intersection of R,S attributes

$$\pi_{xy}(R \bowtie S) =$$

$$\pi_{xy}\{[\pi_{xz}(R)] \bowtie [\pi_{yz}(S)]\}$$

More Rules

$$\pi_{xy}\{\sigma_p(R \bowtie S)\} =$$

$$\pi_{xy}\{\sigma_p[\pi_{xz'}(R) \bowtie \pi_{yz'}(S)]\}$$

$z' = z \cup \{\text{attributes used in } P\}$